

PRELIMINARY DATA SUMMARY

May 1987

U.S. Army Engineer Waterways Experiment Station  
Coastal Engineering Research Center  
Field Research Facility  
Duck, North Carolina

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CERC Field Research Facility  
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Field Research Facility Measurement and Analysis Work Unit at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility in Duck, North Carolina. The data were collected and the analyses performed by the FRF staff. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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## I. INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Fig.1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The FRF consists of a 561-m (1,840 ft) long concrete research pier supported on 0.91 m (3 ft) diameter steel piles. The pier deck is 6.1 m (20 ft) wide, 7.74 m (25.4 ft) above mean sea level (MSL), and extends from behind the dunes to approximately the 7.6 m (25 ft) depth contour. In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Most of the data are daily observations or the results of preliminary data analysis. In many instances, continuous analog records and more extensive analyses will be made available later by the CERC Coastal Engineering Information and Analysis Center (CEIAC).

Table 1 is a list of instruments used, their status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depth at the wave gages and current meters vary and may best be determined from the information contained in Figure 8. Other installation information is contained in Table 1. All times unless otherwise specified are referenced to Eastern Standard Time (EST).

Section II presents the meteorological data; Sections III through VI, oceanographic data; Section VII, nearshore profiles and bathymetry; and Section VIII, if included, documents special events that occurred at the FRF during the month.

Questions and/or comments concerning the data may be directed to Mr. Herman C. Miller at (919) 261-3511.



TABLE 1  
INSTRUMENT STATUS/DATA AVAILABILITY

May 1987

GAGE NUMBER	DESCRIPTION/REMARKS	DEPTH AT SENSOR		DAY OF THE MONTH																													
				1/2/3/4/5/6/7/8/9/10/11/12/13/14/15/16/17/18/19/20/21/22/23/24/25/26/27/28/29/30/31																													
	Barometric Pressure			Instrument Status																													
				Data Collected	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△		
				Analog Record																													
	Precipitation			Instrument Status																													
				Data Collected	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△		
				Analog Record																													
	Air Temperature			Instrument Status																													
				Data Collected	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△		
				Analog Record																													
	Windmeter on Lab Bldg - Elevation 19m (MSL)			Instrument Status																													
				Data Collected	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△		
				Analog Record																													
	Baylor staff located at station 7480 on FRF pier		See profile data	Instrument Status																													
645	Baylor staff located at station 19+00 on FRF pier	See profile data		Data Collected	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△		
625	Baylor staff located at station 19+00 on FRF pier	See profile data		Instrument Status																													
	Pressure gage located 440 m north of FRF pier (0.9 km offshore)	Approx. 7.8 m MSL		Data Collected	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△		
181	Waverider buoy located 6.0km from shore	Approx. 18 m MSL		Instrument Status																													
630	Current meter 500M south (0.5km offshore)	Approx. 6 m MSL		Data Collected	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△		
679	NOAA primary tide station located at seaward end of FRF pier.			Instrument Status																													
				Data Collected	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△		

Instrument Status: Operational □ - Daily Observation: YES □

Data Collected: ALL □, SOME □

Analog Record: ALL □, PARTIAL □

Preliminary Analysis: ALL □, SOME □



## II. METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Fig. 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

The wind measurements are obtained from a Weather Measure Skyvane located on the FRF laboratory building (Fig. 2), 19.1 m above mean sea level (MSL).

The high and low temperatures are obtained from daily readings of NWS maximum and minimum thermometers and represent the extreme temperature values since the last reading.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in) -  
 $mm \times .03937 = in$
2. Millibars (mb) to inches of mercury (in Hg) -  
 $mb \times 0.02953 = in Hg$
3. Degrees Celcius (C) to degrees Fahrenheit (F) -  
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -  
 $m/s \times 1.943 = kn$

TABLE 2: Meteorological Data

MAY 1987

Day	Hour	Wind Speed (m/s)	Wind Direction (deg TN)	Temperature (deg C)	Atm Pressure (mb)	Precipitation (mm)
1	100	4	93	11.8	1012.6	0
	700	6	50	12.0	1011.9	0
	1300	7	23	14.1	1010.9	0
	1900	4	58	12.5	1009.5	0
2	100	5	127	12.9	1010.2	0
	700	4	204	16.7	1010.2	0
	1300	4	215	26.9	1009.9	0
	1900	3	189	21.8	1009.5	0
3	100	2	263	18.0	1010.5	0
	700	2	223	18.1	1013.3	0
	1300	5	124	20.7	1013.3	0
	1900	5	188	21.9	1011.9	0
4	100	6	14	15.4	1013.9	0
	700	5	4	14.8	1014.3	0
	1300	14	0	11.4	1016.3	0
	1900	16	15	9.8	1021.0	0
5	100	13	17	9.1	1022.4	0
	700	10	24	9.2	1023.1	0
	1300	6	22	11.5	1022.4	0
	1900	4	104	10.0	1021.7	0
6	100	2	196	10.0	1020.7	0
	700	7	250	13.5	1020.7	0
	1300	4	216	19.9	1018.3	0
	1900	4	193	17.8	1017.0	0
7	100	5	215	15.4	1017.0	0
	700	6	228	16.6	1017.3	0
	1300	4	211	24.6	1015.3	0
	1900	6	204	19.8	1013.9	0
8	100	5	211	17.3	1013.6	0
	700	6	354	14.8	1014.6	0
	1300	9	23	12.6	1017.0	0
	1900	3	28	11.2	1018.0	0
9	100	2	256	10.0	1019.3	0
	700	5	278	13.9	1022.4	0
	1300	2	86	23.0	1022.1	0
	1900	5	185	18.8	1019.7	0
10	100	7	232	16.4	1020.4	0
	700	10	245	17.6	1020.4	0
	1300	6	250	25.0	1018.7	0
	1900	6	201	22.2	1018.0	0
11	100	7	233	18.3	1019.3	0
	700	7	237	18.7	1020.7	0
	1300	4	244	27.6	1019.7	0
	1900			Software Error		0
12	100					0
	700	7	218	20.2	1018.7	0
	1300	6	207	26.3	1017.7	0
	1900	6	201	22.6	1016.6	0
13	100	6	227	20.7	1018.3	0
	700	6	344	16.0	1021.0	0
	1300	9	9	14.6	1023.4	0
	1900	6	21	13.4	1024.1	0
14	100	5	18	13.6	1024.4	0
	700	5	24	13.5	1025.1	0
	1300	5	11	14.2	1025.1	0
	1900	3	43	13.9	1022.7	0
15	100	2	132	14.3	1021.4	0
	700	4	212	16.2	1020.0	0
	1300	5	243	25.4	1017.0	0
	1900	1	216	20.6	1015.3	2
16	100	4	279	20.2	1016.0	0
	700	12	36	14.1	1020.0	0
	1300	8	20	14.4	1022.1	0
	1900	5	70	12.7	1021.4	0

TABLE 2: Meteorological Data  
MAY 1987

Day	Hour	Wind Speed (m/s)	Wind Direction (deg TN)	Temperature (deg C)	Atm Pressure (mb)	Precipitation (mm)
17	100	5	122	13.1	1021.0	0
	700	3	230	17.6	1021.7	0
	1300	3	202	25.9	1019.3	0
	1900	5	191	22.0	1017.3	0
18	100	6	230	20.5	1017.3	0
	700	7	239	21.7	1017.3	0
	1300	6	252	29.6	1014.9	0
	1900	6	205	25.9	1013.6	0
19	100	7	239	22.5	1013.9	0
	700	4	234	22.1	1015.6	0
	1300	6	60	20.4	1014.9	0
	1900	7	72	16.3	1016.0	0
20	100	3	55	16.6	1016.0	0
	700	5	350	16.0	1017.0	0
	1300	8	353	16.1	1018.0	0
	1900	9	357	14.9	1018.3	0
21	100	7	334	15.7	1018.0	0
	700	11	25	16.1	1019.7	0
	1300	10	43	16.5	1021.7	0
	1900	8	52	15.3	1021.4	0
22	100	5	24	15.2	1023.1	0
	700	2	64	16.5	1023.4	0
	1300	4	102	20.6	1023.7	0
	1900	3	165	20.0	1022.7	3
23	100	3	191	21.5	1023.4	0
	700	2	164	19.0	1024.4	0
	1300	4	140	24.3	1022.7	0
	1900	6	186	24.3	1021.4	0
24	100	5	217	22.2	1021.4	0
	700	7	226	23.3	1021.7	0
	1300	4	211	28.7	1020.7	0
	1900	5	189	25.1	1019.7	0
25	100	6	225	22.8	1020.7	0
	700	4	221	22.8	1021.7	0
	1300	3	62	21.8	1021.7	0
	1900	3	68	17.6	1021.4	0
26	100	5	71	16.8	1022.4	0
	700	7	59	17.0	1024.1	26
	1300	8	66	17.9	1025.1	0
	1900	10	57	17.3	1024.4	0
27	100	8	54	16.3	1025.1	0
	700	6	48	16.8	1025.8	0
	1300			Operator Error		0
	1900	4	64	17.0	1024.4	0
28	100	0		17.2	1024.1	0
	700	2	37	18.7	1025.1	0
	1300	4	114	23.7	1024.4	0
	1900	4	151	21.2	1022.4	0
29	100	5	234	22.0	1021.7	0
	700	4	245	23.0	1022.4	0
	1300	3	201	29.3	1021.4	0
	1900	4	190	25.8	1019.3	0
30	100	7	241	23.3	1020.0	0
	700	4	262	24.7	1020.0	0
	1300	4	120	28.7	1019.7	0
	1900	6	203	27.4	1017.7	0
31	100	6	236	23.5	1019.3	0
	700	7	238	23.2	1019.7	0
	1300	5	213	29.6	1019.0	0
	1900	5	190	26.3	1017.0	0

### III. WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 181) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hrs near 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for 34 minutes.

Wave height ( $H_{mo}$ ) is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. The wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. The period ( $T_p$ ) is that associated with the maximum energy density in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed for all data records collected. Figure 3 is a time history of the  $H_{mo}$  and  $T_p$  values for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

TABLE 3: WAVE DATA

Part 1

MAY 1987

Day	Hour	645		625		181		630	
		Baylor at 7+80 Hmo(m)	T(sec)	Baylor at 19+00 Hmo(m)	T(sec)	Pressure Gage Hmo(m)	T(sec)	Farshr Hmo(m)	Wvrdr T(sec)
1	0100	0.52	12.80	0.68	12.80	0.89	12.80	0.69	12.80
	0700	0.69	11.64	0.76	12.20	0.98	12.20	0.75	12.20
	1300	0.69	11.64	0.77	11.64	0.72	11.64	0.88	11.14
	1900	0.64	11.64	0.73	11.14	0.70	11.64	0.79	5.69
2	0100	0.55	11.14	0.64	11.14	0.65	11.14	0.66	10.24
	0700	0.43	11.14	0.57	10.66	0.63	10.66	0.64	10.66
	1300	0.28	10.66	0.47	10.24	0.54	11.14	0.51	8.83
	1900	0.44	3.08	0.54	10.24	0.49	9.84	0.55	10.24
3	0100	0.34	10.24	0.42	9.14	0.48	9.84	0.49	8.83
	0700	0.28	11.14	0.43	10.66	0.47	5.33	0.57	5.22
	1300	0.43	11.14	0.51	11.14	0.50	11.14	0.60	5.82
	1900	0.38	10.66	0.49	10.66	0.54	10.66	0.59	14.22
4	0100	0.41	10.24	0.51	10.24	0.57	10.66	0.54	11.14
	0700	0.56	4.57	0.62	9.84	0.61	10.24	0.73	10.24
	1300	1.50	5.45	1.43	5.56	1.11	5.33	1.81	5.69
	1900	1.98	6.92	2.26	6.92	1.91	7.32	2.51	6.57
5	0100	2.02	8.26	2.22	7.76	2.12	8.53	2.52	7.32
	0700	1.70	9.14	1.73	9.48	1.61	8.83	2.14	9.48
	1300	1.25	9.14	1.36	8.83	1.35	8.53	1.43	8.83
	1900	0.94	8.53	0.98	8.53	1.02	8.53	1.07	8.00
6	0100	0.61	7.32	0.77	8.26	0.81	8.00	0.90	7.53
	0700	0.44	6.74	0.59	8.26	0.66	8.26	0.80	7.32
	1300	0.40	7.32	0.55	7.53	0.62	7.76	0.66	8.83
	1900	0.33	12.20	0.50	12.20	0.56	12.20	0.69	8.26
7	0100	0.28	12.20	0.45	12.20	0.58	12.20	0.66	11.64
	0700	0.32	11.64	0.46	11.64	0.65	12.20	0.71	8.26
	1300	0.39	8.26	0.58	9.14	0.79	8.26	0.76	8.00
	1900	0.44	8.83	0.69	8.26	0.95	9.48	0.86	8.53
8	0100	0.42	8.83	0.64	8.83	0.84	8.83	0.85	8.83
	0700	0.33	9.14	0.66	9.14	0.79	9.14	0.83	9.14
	1300	1.45	5.45	1.45	5.69	1.24	5.33	1.52	9.14
	1900	0.95	5.82	1.03	8.83	1.00	8.83	1.14	8.83
9	0100	0.83	6.24	0.98	8.53	1.01	8.53	1.12	8.83
	0700	0.70	7.11	0.87	8.83	0.91	8.83	0.91	8.53
	1300	0.71	6.09	0.76	6.57	0.82	8.26	0.84	8.53
	1900	0.50	6.74	0.65	8.83	0.70	8.83	0.69	8.26
10	0100	0.29	9.14	0.61	8.53	0.74	8.26	0.76	8.53
	0700	0.27	9.14	0.52	9.14	0.72	8.83	0.73	8.83
	1300	0.26	8.26	0.46	8.53	0.63	8.83	0.54	8.26
	1900	0.37	8.53	0.49	8.26	0.51	9.14	0.52	8.53
11	0100	0.24	8.26	0.31	8.53	0.42	8.26	0.51	8.26
	0700	0.24	8.83	0.30	8.53	0.41	8.53	0.43	8.00
	1300								
	1900								
12	0100								
	0700	0.23	10.24	0.29	9.84	0.39	11.14	0.42	16.00
13	0100	0.37	16.00	0.36	16.00	0.39	16.00	0.45	8.26
	0700	0.20	10.24	0.30	15.06	0.37	16.00	0.48	3.37
	1300	0.25	15.06	0.33	15.06	0.41	15.06	0.40	7.32
	1900	1.18	6.24	1.14	5.95	0.84	6.09	1.37	5.95
14	0100	1.38	8.26	1.19	8.53	1.27	8.00	1.40	8.83
	0700	1.13	8.26	1.20	8.53	1.20	8.26	1.29	8.26
	1300	0.94	6.24	0.95	8.83	0.98	8.53	1.09	8.26
	1900	0.70	7.76	0.96	8.53	0.87	9.14	1.01	8.00
15	0100	0.74	8.53	0.85	8.00	1.00	9.14	0.94	9.14
	0700	0.45	7.76	0.70	7.32	0.78	8.83	0.82	6.92
	1300	0.43	8.26	0.59	8.26	0.68	7.76	0.62	7.76
	1900	0.39	7.11	0.53	7.76	0.59	9.14	0.66	7.32
16	0100	0.34	9.48	0.46	9.48	0.63	9.14	0.56	9.48
	0700	1.50	5.02	1.48	4.74	1.02	4.74	1.44	5.02
	1300	1.35	5.82	1.13	5.56	0.94	5.69	1.24	5.56
	1900	0.86	5.56	0.95	5.69	0.84	5.02	0.97	5.56

\* Electronic problems

TABLE 3: WAVE DATA

Part 2

MAY 1987

Day	Hour	645		625		181		630	
		Baylor Hmo(m)	at 7+80 T(sec)	Baylor Hmo(m)	at 19+00 T(sec)	Pressure Hmo(m)	Gage T(sec)	Farshr Hmo(m)	Wvrdr T(sec)
17	0100	0.73	6.92	0.99	6.92	1.00	7.11	0.98	7.32
	0700	0.66	6.09	0.94	6.92	1.00	8.26	1.01	7.11
	1300	0.51	5.95	0.78	9.14	0.82	9.84	0.85	9.84
	1900	0.44	9.84	0.67	8.53	0.78	9.14	0.74	9.14
18	0100	0.36	9.48	0.49	9.14	0.62	9.14	0.59	9.48
	0700	0.35	8.83	0.47	9.14	0.58	8.26	0.52	8.53
	1300	0.26	8.83	0.34	9.14	0.46	9.48	0.38	8.83
	1900	0.29	8.53	0.39	8.83	0.40	8.83	0.39	8.83
19	0100	0.18	9.48	0.27	8.53	0.32	8.83	0.44	8.53
	0700	0.23	8.83	0.30	9.14	0.33	8.83	0.34	8.53
	1300	0.22	8.83	0.28	8.53	0.29	8.53	0.37	8.53
	1900	0.83	4.83	0.76	4.41	0.47	4.27	1.05	4.66
20	0100	0.77	6.57	0.74	6.92	0.55	6.92	1.03	6.92
	0700	1.28	8.53	1.25	8.26	0.99	8.00	1.23	8.53
	1300	1.24	7.76	1.36	8.83	1.27	8.00	1.41	7.53
	1900	1.37	8.83	1.55	8.53	1.39	9.84	1.61	9.48
21	0100	1.14	9.14	1.45	9.84	1.64	9.48	1.63	9.14
	0700	1.39	10.66	1.70	10.66	1.94	10.66	1.78	9.14
	1300	1.27	10.24	1.85	10.24	1.85	9.84	2.01	10.24
	1900	1.30	10.66	1.83	10.24	2.08	9.84	2.06	9.84
22	0100	1.00	10.24	1.63	9.14	1.76	9.48	1.52	9.84
	0700	0.95	9.84	1.44	10.24	1.74	9.84	1.51	9.48
	1300								
	1900								
23	0100								
	0700								
	1300								
	1900								
24	0100								
	0700								
	1300								
	1900								
25	0100								
	0700								
	1300								
	1900								
26	0100								
	0700								
	1300	0.98	5.45	1.12	5.82	0.98	6.24	1.26	6.57
	1900	0.91	5.02	1.20	8.83	1.11	8.83	1.35	8.26
27	0100	1.00	5.56	1.15	7.53	1.07	8.00	1.30	9.14
	0700	0.85	6.40	1.14	8.83	1.02	7.53	1.19	5.95
	1300								
	1900	0.68	7.76	0.99	8.53	0.85	8.26	1.04	8.53
28	0100	0.65	8.00	0.88	9.14	1.04	8.26	1.05	8.53
	0700	0.62	8.00	0.93	8.26	0.95	8.83	1.03	7.53
	1300	0.61	7.32	0.83	8.83	0.93	8.26	0.99	7.76
	1900	0.58	7.76	0.85	7.76	0.88	8.00	1.06	8.26
29	0100	0.54	8.26	0.75	8.83	1.01	8.26	0.95	7.32
	0700	0.49	9.14	0.76	8.26	0.84	8.53	0.92	8.26
	1300	0.41	9.48	0.59	8.83	0.77	8.26	0.78	7.32
	1900	0.39	8.83	0.62	8.00	0.78	8.00	0.67	8.00
30	0100	0.38	13.48	0.62	13.48	0.71	8.00	0.69	8.00
	0700	0.45	12.80	0.59	12.80	0.79	12.80	0.63	12.20
	1300	0.32	12.80	0.54	12.20	0.71	12.20	0.57	12.20
	1900	0.40	11.64	0.59	12.20	0.70	12.20	0.65	12.20
31	0100	0.33	12.20	0.52	12.20	0.64	11.64	0.57	11.64
	0700	0.37	11.14	0.49	11.64	0.62	11.64	0.61	11.64
	1300	0.23	11.64	0.39	11.64	0.54	11.64	0.44	11.64
	1900	0.35	11.14	0.43	11.14	0.48	11.14	0.59	11.14
Mean		0.66	8.88	0.81	9.29	0.85	9.27	0.92	8.66
Std dev		0.42	2.42	0.43	2.16	0.40	2.18	0.46	1.97

\* Electronic problems

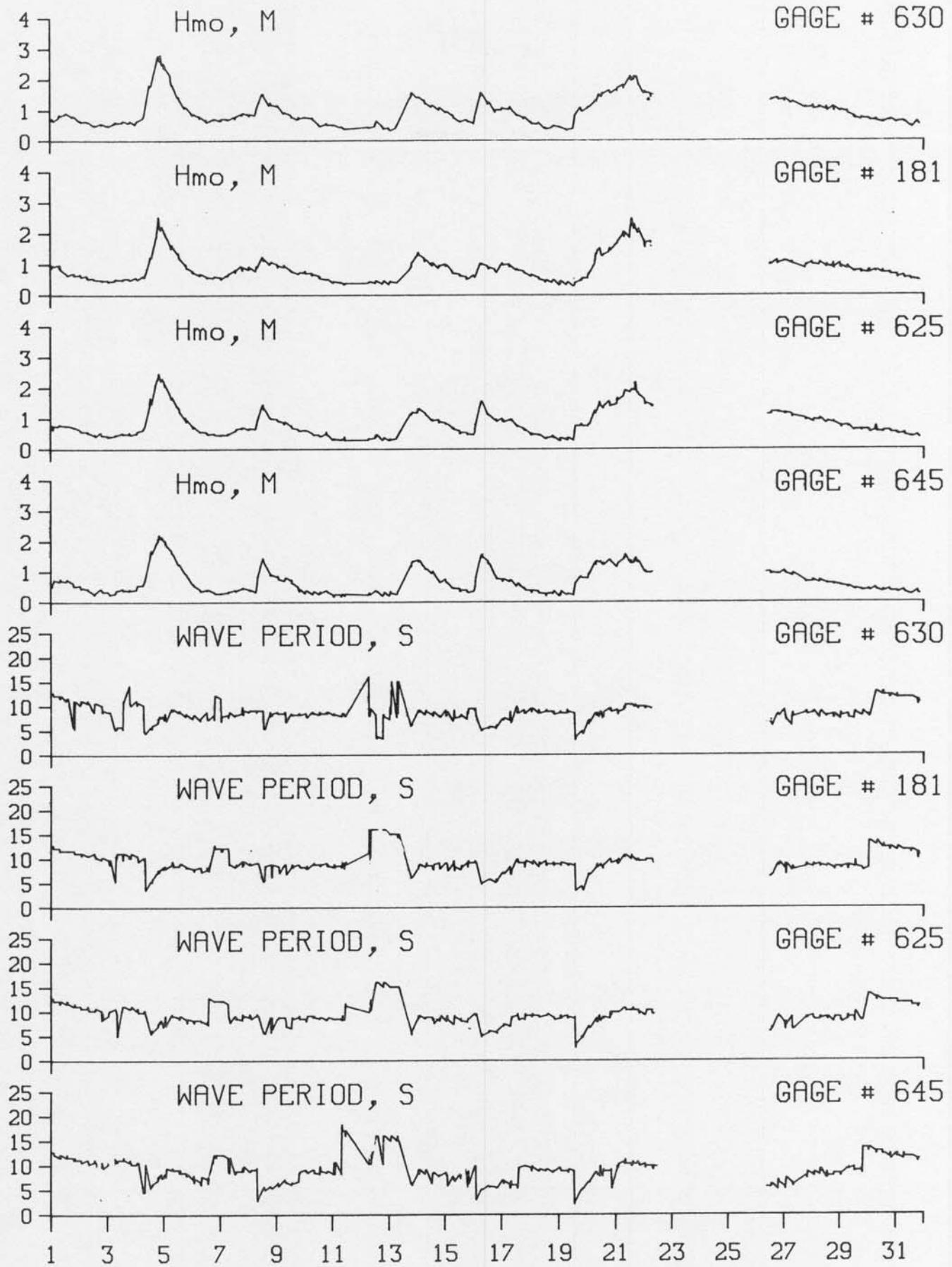


FIGURE 3. Time History of Wave Heights and Periods - May 1987

#### IV. CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, alongshore currents flow either toward 340 (i.e. northward) or toward 160 (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second.

TABLE 4: Current Data  
MAY 1987

Day	Time	Pier Measurements						Beach Measurements			Current Meter	
		Alongshore Cross-shore Resultant		Dye at (579 m) surface	Distance from Baseline (m)	Dye at Mid-Surf Zone (surface)		(500m Updrift)			South Tripod Depth -4.8m (NGVD)	ID #679
		Speed	Dir	Speed	Dir	Location	Speed	Dir	Speed	Dir		
1	0100-Along Cross Result								6	S		
1	0700-Along Cross Result	68 17 70	S on 174	152		55 19 59	S on 179	North	37	S	1 4 4	S on 236
1	1300-Along Cross Result										17 3 17	S on 170
1	1900-Along Cross Result										15 2 15	S on 168
2	0100-Along Cross Result										8 0 8	S
2	0700-Along Cross Result	9 3 9	N off 357	201		1 0 1	N off 2	South	5	N	4 1 4	N off 354
2	1300-Along Cross Result										1 3 3	S on 232
2	1900-Along Cross Result										6 0 6	N 340
3	0100-Along Cross Result										8 2 8	S on 174
3	0700-Along Cross Result	0 0		189		8 2 8	S on 174	South	2	N	7 2 7	S on 176
3	1300-Along Cross Result										11 2 11	S on 170
3	1900-Along Cross Result										11 0 11	S 160
4	0100-Along Cross Result										13 4 14	S on 177
4	0700-Along Cross Result	76 0 76	S 0 160	189		122 0 122	S 160	North	104	S	22 6 23	S on 175
4	1300-Along Cross Result										57 2 57	S on 162
4	1900-Along Cross Result										60 5 60	S on 165
5	0100-Along Cross Result										49 0 49	S 160
5	0700-Along Cross Result	61 0 61	S 0 160	238		44 11 45	S on 174	North	53	S	40 0 40	S 160
5	1300-Along Cross Result										14 2 14	S on 168
5	1900-Along Cross Result										10 3 10	S on 177

KEY = All speeds in CM/SEC  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

TABLE 4: Current Data  
MAY 1987

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter at South Tripod	
		Dye at (579 m) (surface) Speed	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	Depth -4.8m (NGVD)	ID #679
6 0100	Along Cross Result									3	N
										4	off
										5	33
6 0700	Along Cross Result	12 12 18	N on 295	140	6 13 14	S off 94	North	1	S	14 3 14	N off 352
6 1300	Along Cross Result									8 2 8	N off 354
6 1900	Along Cross Result									0 2 2	off 70
7 0100	Along Cross Result									13 4 14	N off 357
7 0700	Along Cross Result	10 20 22	N off 43	140	38 6 39	N off 349	South	8	S	9 3 9	N off 358
7 1300	Along Cross Result									8 0 8	N 340
7 1900	Along Cross Result									19 1 19	N on 337
8 0100	Along Cross Result									11 0 11	N 250
8 0700	Along Cross Result	24 15 28	S on 191	250	0 0 3	81	South	12	N	0 1 1	on 250
8 1300	Along Cross Result									23 20 30	S on 201
8 1900	Along Cross Result									18 7 19	S on 181
9 0100	Along Cross Result									12 12 17	S on 205
9 0700	Along Cross Result	41 4 41	S on 166	274	24 7 25	S off 143	North	17	S	15 2 15	S on 168
9 1300	Along Cross Result									25 0 25	S 160
9 1900	Along Cross Result									23 1 23	S off 158
10 0100	Along Cross Result									3 4 5	S off 107
10 0700	Along Cross Result	no observ		165	17 10 20	N on 309	South	14	N	6 1 6	N off 349
10 1300	Along Cross Result									9 3 9	N off 358
10 1900	Along Cross Result									12 11 16	N on 297

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TABLE 4: Current Data  
MAY 1987

Day	Time	Pier Measurements				Beach Measurements				Current Meter at South Tripod	
		Alongshore Cross-shore Resultant		Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	(500m Updrift)		Dye 12m offshore (surface)	Location	Speed	Dir
		Dye at (579 m) surface	Speed	Dir						Speed	Dir
11	0100-Along Cross Result									5	N off 11
11	0700-Along Cross Result	0 10 10	off 70	140	5 4 6	N off 17	North	12	N	2 1 2	N off 7
11	1300-Along Cross Result										
11	1900-Along Cross Result										
12	0100-Along Cross Result										
12	0700-Along Cross Result	17 8 19	N off 7	140	11 3 12	N off 354	South	11	N	4 2 4	N off 7
12	1300-Along Cross Result									8 2 8	N off 354
12	1900-Along Cross Result									22 1 22	N on 337
13	0100-Along Cross Result									5 1 5	N off 351
13	0700-Along Cross Result	17 0 17	S 160	152	24 1 24	S off 157	North	20	S	3 3 4	S on 205
13	1300-Along Cross Result										
13	1900-Along Cross Result									31 6 32	S on 171
14	0100-Along Cross Result									38 7 39	S on 170
14	0700-Along Cross Result	44 0 44	S 160	213	23 47 52	S on 223	North	49	S	33 4 33	S on 167
14	1300-Along Cross Result									32 6 33	S on 171
14	1900-Along Cross Result									7 5 9	S on 196
15	0100-Along Cross Result									14 5 15	S on 180
15	0700-Along Cross Result	5 17 18	S off 86	152	9 12 25	N off 25	South	4	N	3 2 4	S off 126
15	1300-Along Cross Result									2 1 2	S on 187
15	1900-Along Cross Result									11 1 11	N off 345

KEY = All speeds in CM/SEC

N = Northward, Shore parallel

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TABLE 4: Current Data  
MAY 1987

Day	Time	Pier Measurements				Beach Measurements				Current Meter at South Tripod Depth -4.8m (NGVD) ID #679	
		Dye at (579 m) (surface) Speed	Dye at (579 m) (surface) Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	(500m Updrift) Dye 12m offshore (surface) Location	Speed	Dir	Speed	Dir
16	0100-Along Cross Result									6 1 6	N on 331
16	0700-Along Cross Result	38 0 38	S on 160	226	41 12 42	S on 177	North	49	S	23 2 23	S on 165
16	1300-Along Cross Result									29 6 30	S on 172
16	1900-Along Cross Result									9 5 10	S on 189
17	0100-Along Cross Result									1 2 2	N on 277
17	0700-Along Cross Result	9 10 14	N off 30	250	0 15 15	off 70	South	23	N	7 1 7	N off 348
17	1300-Along Cross Result									3 2 4	N off 14
17	1900-Along Cross Result									17 2 17	N off 347
18	0100-Along Cross Result									19 1 19	N off 343
18	0700-Along Cross Result	18 13 22	N off 17	140	11 11 15	N off 25	South	33	N	8 0 8	N N 340
18	1300-Along Cross Result									4 1 4	S on 174
18	1900-Along Cross Result									2 2 3	N off 25
19	0100-Along Cross Result									1 1 1	S off 115
19	0700-Along Cross Result	4 0 4	N off 346	140	10 2 10	N off 351	South	3	N	7 4 8	S on 190
19	1300-Along Cross Result									13 5 14	S on 181
19	1900-Along Cross Result									40 8 41	S on 171
20	0100-Along Cross Result									13 1 13	S off 156
20	0700-Along Cross Result	61 0 61	S on 160	165	36 11 37	S on 177	North	38	S	18 2 18	S on 166
20	1300-Along Cross Result									47 2 47	S on 162
20	1900-Along Cross Result									22 4 22	S off 150

KEY = All speeds in CM/SEC

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TABLE 4: Current Data  
MAY 1987

Day	Time	Pier Measurements				Beach Measurements				Current Meter				
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	(500m Updrift)	Dye 12m offshore (surface)	Location	Speed	Dir	at South Tripod Depth -4.8m (NGVD) ID #679
21	0100-Along Cross Result											19	S	
												0		
												19	160	
21	0700-Along Cross Result	47 5 47	S off 154		250		41 41 57	S off 115		no observation		26 1 26	S on 162	
21	1300-Along Cross Result											5 1 5	S on 171	
21	1900-Along Cross Result											4 7 8	S on 220	
22	0100-Along Cross Result											5 2 5	S on 182	
22	0700-Along Cross Result	7 1 7	S off 151		213		12 15 20	N on 289		South	11	S	10 1 10	S on 166
22	1300-Along Cross Result													
22	1900-Along Cross Result													
23	0100-Along Cross Result													
23	0700-Along Cross Result	0 3 3	off 70		152		87 22 90	N off 354		South	34	N		
23	1300-Along Cross Result													
23	1900-Along Cross Result													
24	0100-Along Cross Result													Software Error
24	0700-Along Cross Result	17 13 22	N off 17		143		68 3 68	N off 343		South	52	N		Software Error
24	1300-Along Cross Result													S
24	1900-Along Cross Result													
25	0100-Along Cross Result													
25	0700-Along Cross Result	14 10 17	S off 123		152		5 5 7	N on 295		South	16	N		
25	1300-Along Cross Result													
25	1900-Along Cross Result													

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TABLE 4: Current Data  
MAY 1987

Day	Time	Pier Measurements				Beach Measurements				Current Meter at South Tripod	
		Alongshore Cross-shore Resultant	Dye at (579 m) surface	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	(500m Updrift)	Depth -4.8m (NGVD)
26	0100-Along Cross Result										ID #679
26	0700-Along Cross Result	68 17 70	S on 174			12 18 22	N on 284			Dye 12m offshore (surface)	Speed Dir
26	1300-Along Cross Result									Location	
26	1900-Along Cross Result									Speed	
27	0100-Along Cross Result									Dir	
27	0700-Along Cross Result	30 8 31	S off 146			0 10 10	on 250			27 6 28	S on 173
27	1300-Along Cross Result									23 13 26	S on 189
27	1900-Along Cross Result									25 1 25	S on 162
28	0100-Along Cross Result									27 2 27	S on 164
28	0700-Along Cross Result	34 0 34	S 160			55 55 78	N on 295			27 5 27	S on 170
28	1300-Along Cross Result									21 1 21	S on 163
28	1900-Along Cross Result									16 0 16	S 160
29	0100-Along Cross Result									6 0 6	S 160
29	0700-Along Cross Result	9 9 12	N off 25			38 6 39	N on 331			2 1 2	N off 7
29	1300-Along Cross Result									4 3 5	N on 303
29	1900-Along Cross Result									14 2 14	N off 348
30	0100-Along Cross Result									1 1 1	N on 295
30	0700-Along Cross Result	8 4 9	N off 7			0 6 6	off 70			0 1 1	N on 250
30	1300-Along Cross Result									11 6 13	S on 189
30	1900-Along Cross Result									2 0 2	N 340

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TABLE 4: Current Data  
MAY 1987

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements				Current Meter at South Tripod	
		Dye at (579 m) surface	Speed	Dir	Distance from Baseline (m)	Speed	Dir	(500m Updrift) Dye 12m offshore (surface)	Location	Speed	Dir
31	0100-Along Cross Result									6	S
										1	off
										6	151
31	0700-Along Cross Result	0			140	0		South	9 S	3	S
		10	off			0				4	off
		10	70			0				5	107
31	1300-Along Cross Result									6	S
										8	on
										10	213
31	1900-Along Cross Result									7	N
										3	off
										8	3

KEY = All speeds in CM/SEC  
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## V. SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) taken at the seaward end of the pier are made of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves) but not surface chop or capillary waves. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring alignment of the wave crests. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 east of true north; consequently, wave angles greater than 70 imply the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are made daily at the seaward end of the FRF pier. A jar along with a thermometer is lowered about .3 m (1 ft) into the water and allowed to remain for at least one minute. The jar is removed, the temperature read and a hydrometer is used to determine the density. A secci disc is used to determine the surface visibility.

TABLE 5

## SUPPLEMENTAL OBSERVATIONS

MAY 1987

DAY	TIME	WAVE APPROACH ANGLE AT PIER END		RADAR WAVE ANGLE deg from True N	WIDTH OF SURF ZONE(m)	WATER CHARACTERISTICS AT PIER END		
		Primary	Secondary			TEMP(C)	DENSITY (g/cc)	SECCI VIS(m)
1	952	70		70	72	12.9	1.0172	0.9
2	1047	no observation			2	14.3		2.1
3	1015	40	35		2	13.4		2.1
4	1150	20		70	149	13.9	1.0192	1.8
5	845	50		50	332	12.8	1.0170	0.3
6	845	40			96	13.9	1.0205	1.2
7	845	105	70		113	12.3	1.0223	1.2
8	843	30	75	35	53	11.1	1.0236	0.9
9	825	40	45		0	12.2	1.0234	3.0
10	1300	45	50		0	13.9	1.0238	3.0
11	1057	110			94	12.6	1.0230	2.1
12	930	120			88	13.6	1.0235	2.7
13	1013	40			113	12.9	1.0233	3.7
14	1010	55		65	137	14.4	1.0203	2.1
15	938	75			96	16.2	1.0195	2.1
16	1100	50	65	70	146	16.1	1.0204	1.8
17	1052	55	50		62	16.1	1.0204	2.7
18	915	none visible			82	16.1	1.0208	2.7
19	515	none visible			52	16.4	1.0225	3.7
20	518	60			131	18.4	1.0171	2.1
21	600	50		60	329	17.0	1.0180	1.5
22	750	90		90	337	16.7	1.0184	1.8
23	900	95			201	18.4	1.0218	2.4
24	911	85			110	16.1	1.0220	1.5
25	930	none visible			85	15.5	1.0236	2.4
26	800	60		280	122	18.3	1.0198	0.9
27	712	70			122	20.0	1.0182	1.5
28	1005	100		95	111	20.5	1.0170	0.9
29	715	95		90	85	18.6	1.0206	1.5
30	1008	100		80	67	18.4	1.0210	2.4
31	1026	100		80	61	16.1	1.0227	2.4

## VI. WATER LEVELS

The National Ocean Services (NOS) has established a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect data every 6 minutes throughout the month.

Figure 4 shows the variation in mean water levels computed over a tidal cycle period (12.42 hours), and contains a list of selected mean and extreme values. This presentation is useful in identifying effects on both meteorological and astronomical forces on the open coast water levels.

Table 6 contains the time of the center of each sampling interval and the range, high, low, and mean water levels during each tidal cycle.

FRF TIDE HEIGHTS  
MAY 1987

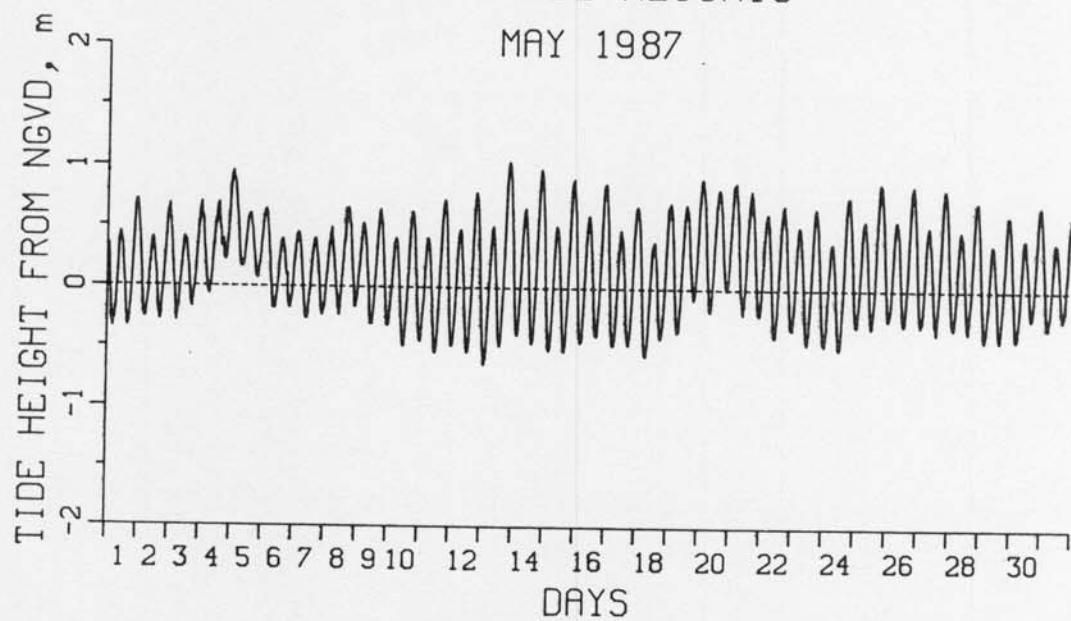


FIGURE 4. Time History of Mean Water Levels, May 1987

MONTHLY WATER LEVELS (METERS MSL)

Extreme Low -	-0.64 on 13 May at 0036 hrs.
Extreme High -	1.04 on 13 May at 1906 hrs.
Monthly Mean -	0.16
Mean Low -	-0.32
Mean High -	0.64
Mean Range -	0.96

Table 6: WATER LEVELS (METERS NGVD)

MID-CYCLE DAY TIME		LOW	HIGH	MEAN	RANGE
1	612	-0.34	0.45	0.08	0.79
1	1837	-0.33	0.72	0.19	1.05
2	703	-0.26	0.41	0.07	0.66
2	1928	-0.28	0.68	0.19	0.96
3	753	-0.29	0.41	0.11	0.70
3	2018	-0.17	0.70	0.26	0.87
4	843	-0.06	0.70	0.30	0.76
4	2109	0.22	0.96	0.59	0.74
5	934	0.16	0.61	0.39	0.44
5	2159	0.07	0.65	0.35	0.58
6	1024	-0.18	0.40	0.11	0.58
6	2249				
7	1115	-0.26	0.40	0.08	0.66
7	2340	-0.23	0.49	0.11	0.72
8	1205	-0.23	0.66	0.23	0.89
9	30	-0.16	0.53	0.19	0.69
9	1255	-0.30	0.65	0.16	0.95
10	121	-0.32	0.41	0.06	0.73
10	1346	-0.49	0.63	0.08	1.12
11	211	-0.45	0.41	0.01	0.86
11	1436	-0.54	0.73	0.10	1.27
12	301	-0.48	0.48	0.01	0.97
12	1527	-0.54	0.79	0.12	1.33
13	352	-0.64	0.51	-0.05	1.15
13	1617	-0.48	1.04	0.29	1.52
14	442	-0.39	0.66	0.14	1.05
14	1707	-0.46	0.98	0.26	1.44
15	532	-0.52	0.52	0.01	1.03
15	1758	-0.53	0.91	0.18	1.43
16	623	-0.45	0.61	0.08	1.06
16	1848	-0.40	0.87	0.24	1.27
17	713	-0.48	0.49	0.01	0.96
17	1938	-0.47	0.68	0.11	1.15
18	804	-0.56	0.39	-0.08	0.95
18	2029	-0.41	0.71	0.14	1.13
19	854	-0.36	0.70	0.18	1.07
19	2119	-0.09	0.91	0.42	1.00
20	944	-0.18	0.83	0.35	1.01
20	2210	-0.01	0.88	0.43	0.89
21	1035	-0.20	0.82	0.32	1.03
21	2300	-0.21	0.63	0.22	0.84
22	1125	-0.40	0.70	0.14	1.09
22	2350	-0.34	0.52	0.11	0.86
23	1216	-0.45	0.68	0.11	1.13
24	41	-0.47	0.42	0.00	0.88
24	1306	-0.50	0.77	0.12	1.26
25	131	-0.30	0.58	0.16	0.88
25	1356	-0.31	0.88	0.28	1.20
26	222	-0.25	0.58	0.19	0.83
26	1447	-0.29	0.87	0.27	1.16
27	312	-0.30	0.55	0.14	0.85
27	1537	-0.36	0.84	0.24	1.20
28	402	-0.32	0.49	0.09	0.81
28	1628	-0.35	0.74	0.20	1.09
29	453	-0.42	0.38	0.00	0.81
29	1718	-0.42	0.62	0.10	1.05
30	543	-0.41	0.43	0.01	0.84
30	1808	-0.23	0.70	0.22	0.94
31	634	-0.31	0.40	0.05	0.72
31	1859	-0.25	0.61	0.15	0.86

## VII. NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in April and the three surveys taken during May on profile line 188, located 517 m south of the pier. On the foreshore (60 to 120 m), a small amount of accretion is visible. The nearshore bar migrated 40 m shoreward while the seaward face of the bar (200 to 280 m) steepened. Only minor changes are visible on the remainder of the profile.

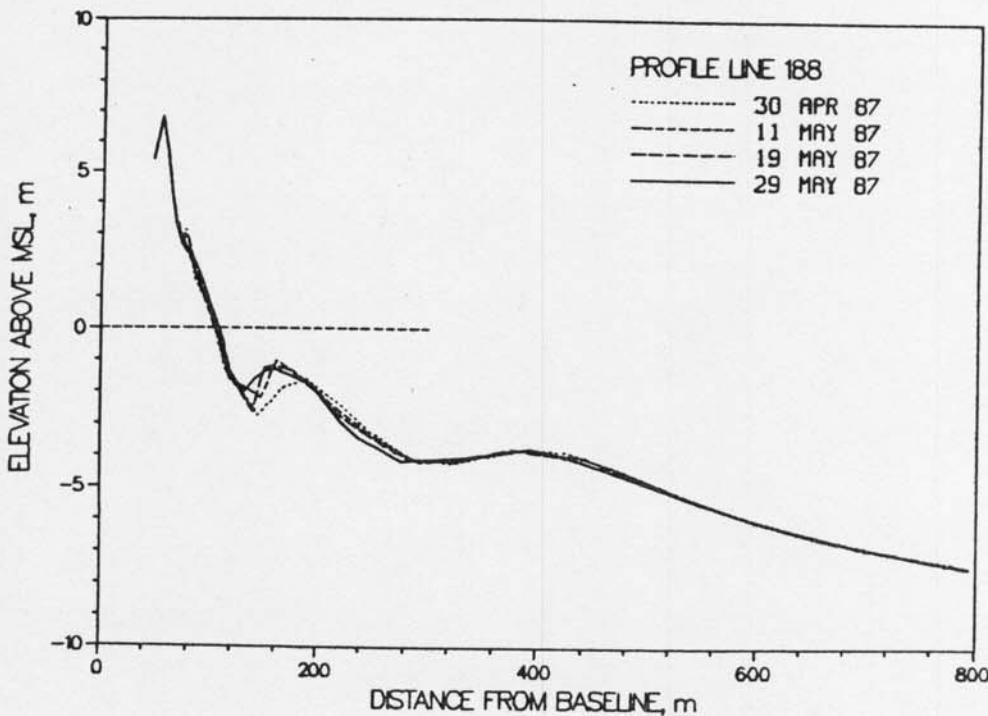


Figure 5. Monthly CRAB profiles on profile 188 - 517 meters south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile since the end of 1986. The change in the nearshore (160 m) is a result of the shoreward migration of the nearshore bar while the change further offshore (220 to 300 m) represents the steepening of the seaward slope of the nearshore bar.

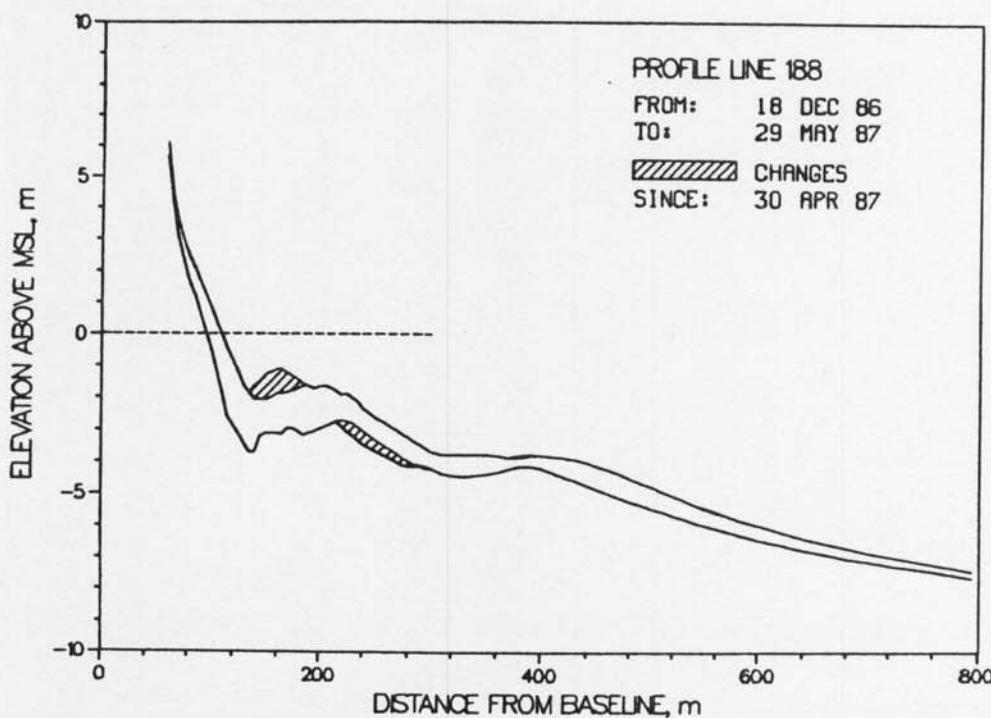


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. There was no bathymetric survey in May. Included for reference is the April survey (Figure 7).

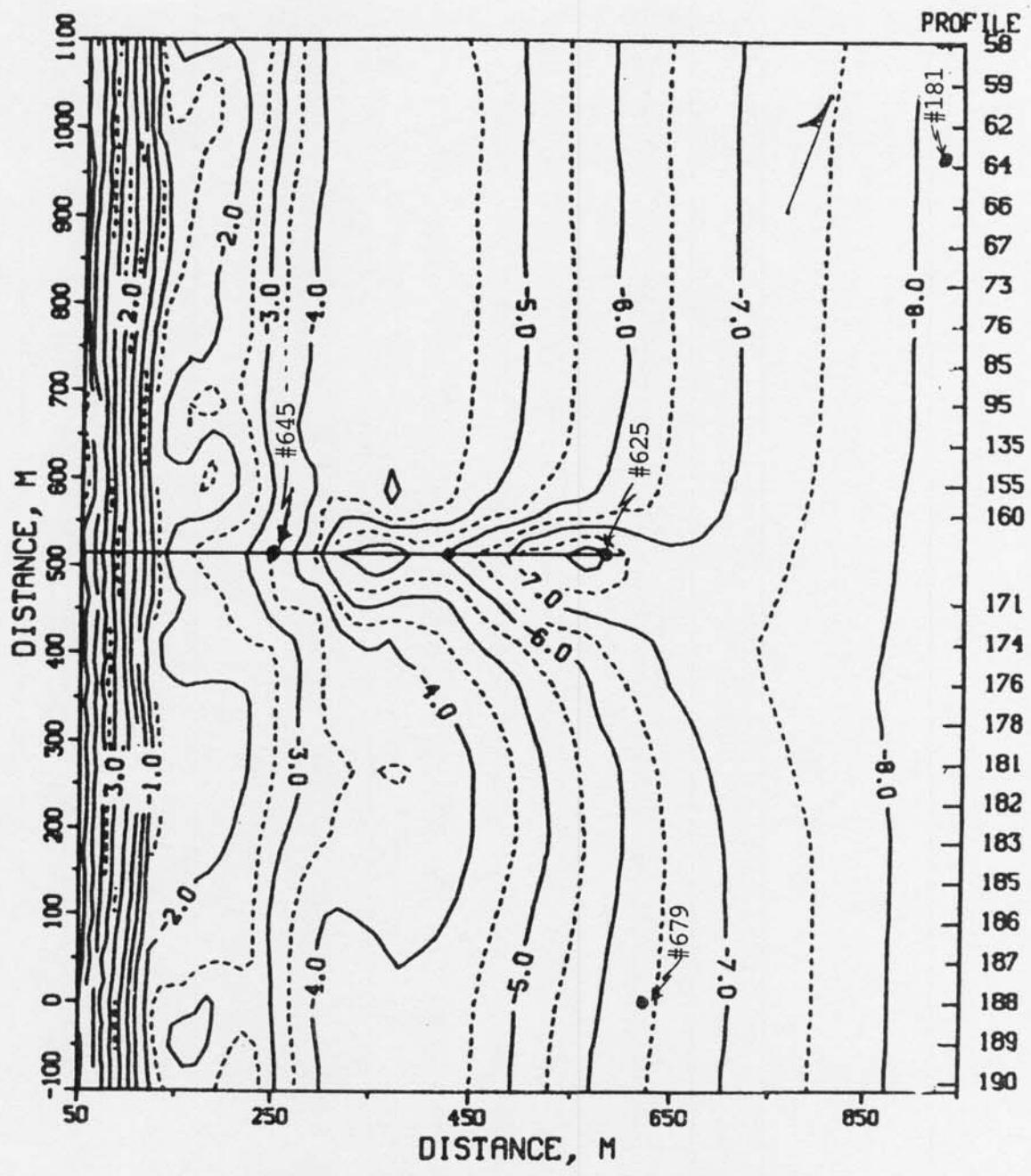


Figure 7. FRF BATHYMETRY 2 APR 87  
CONTOURS IN METERS

## VIII. SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the wave height at the seaward end of the pier (i.e. as measured by the Baylor Gage #625 at pier station 19+00) exceeded 2 m. When this occurred, four contiguous 34-min wave records were obtained every hour:

<u>Start</u>	<u>End</u>
4 May (1900)	5 May (0242)

B. Storm Synopsis.

4-5 May - Strong onshore winds generated by a large Canadian high pressure system in conjunction with a weak low pressure system developed on 4 May. That day, maximum onshore winds exceeded 16 m/s (NNE) at 1742 hrs and maximum Hmo of 2.46 m (period = 8.26 sec) at Gage 625 was recorded at 2042 hrs. The barometric pressure did not drop and there was no precipitation at the FRF.

### Distribution List

#### Government Agencies:

OCE	U.S. Geological Survey
BERH	U.S. National Park Service
NAO	U.S. Naval Academy
NASA/Wallops Flight Center	U.S. Naval Civil Eng. Lab
NOAA (NOS, NWS)	U.S. Naval Fac. Eng. Com.
SAD	U.S. Naval Oceanographic Off.
SAW	U.S. Naval Research Lab

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Old Dominion University	University of North Carolina
Oregon State University	University of N. Colorado
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Southern Illinois University	

#### Others:

City of Va. Beach, VA	MEC Systems Corporation
Coastal Barge Corporation	Moffatt & Nichol, Eng.
Coastal and Est. Res., Inc.	Offshore Coastal Technologies
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